benefit from the application of the same management practices to above-normal inventories that are usually employed by private companies for normal inventories. Moreover, the private firms would share the cost of the extra inventories, and government incentives would be kept at a level well below the total cost.

The disadvantages include the administrative complexities of maintaining central information and control by the federal government, the difficulties of policing, the potential for abuse by participating companies, and the cost of the program to the federal government. In addition, such a policy could encourage private users to reduce their nonsubsidized normal inventories and rely instead on subsidized inventories. To illustrate the federal cost of a private stockpile program, the Holt and Stanley study estimates that the government would have to provide $50 million to $60 million in incentives to yield a 4 million pound addition to normal cobalt inventories for a ten-year period. 4/ A 4 million pound addition would more than double average private inventories held between 1977 and 1981 and would be equal to about an average of three months' U.S. imports. At current market prices, this quantity of cobalt could be purchased for about $20 million. The Holt-Stanley study assumes higher prices for cobalt than those that now prevail.

If the policy goal was to prepare for minerals disruptions that would compromise the national defense effort, then selected incentives could be created to induce defense contractors to hold larger inventories. Defense procurement contracts could include subsidization of mineral inventories or, alternatively, specified inventory levels could be made a condition of receiving such a contract.

SUBSIDIZATION OF DOMESTIC PRODUCTION

Title III of the Defense Production Act (DPA) of 1950 authorized the President to guarantee loans and to take other financial steps to expand productive capacity and supply in the interest of national defense. Under this legislation, a $2 billion authorization was enacted to meet shortages during the Korean War. Over the ensuing decade, this funding generated about $8.4 billion in additional production. Aluminum production in the United States doubled, tungsten mining quadrupled, copper mining capacity increased by a fourth, domestic nickel and titanium production was developed, and foreign columbium-tantalum mining and processing facilities were greatly expanded. Over $1 billion worth of materials acquired under this

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4. Ibid.

authority was sold to private users during the 1950s, at prices that recovered about 93 percent of the government's purchase cost. 5/

But, in general, the results achieved through the use of Title III authority were expensive. In addition to long-term purchase contracts at guaranteed prices, producers received direct subsidies (subsidized exploration costs and subsidized power for an aluminum producer, as well as direct payments for the production of columbium-tantalum, copper, and graphite), government guaranteed loans, loans at subsidized interest rates for new or expanded facilities, and very rapid depreciation schedules for tax purposes. By mid-1959, stockpile inventories had been acquired by the government under the purchase contracts at the cost of about $1.4 billion but had an estimated market value of only $843 million. The inventories eventually became part of the strategic stockpile.

In the case of cobalt, domestic producers were paid $2.38 per pound, while foreign producers received the existing world market price of $1.29 per pound. 6/ The domestic producers ceased production when their government purchase contracts expired. Excess government cobalt inventories were sold between 1966-1969 at prices ranging from $1.53 to $1.72 per pound.

While U.S. production of tungsten quadrupled between 1950 and 1955, it dropped by 50 percent in 1957, the first year after government purchases were terminated. 7/ By 1960, production of domestic tungsten concentrate was only two-thirds larger than in 1950 and supplied slightly more than half of U.S. consumption. The domestic price of tungsten stayed at the government guaranteed price of $3.97 per pound until the termination of contracts in 1957, when it dropped to $1.18 per pound.

Titanium, columbium-tantalum, and manganese offer further instances in which the market value of DPA inventories in 1959 were 50 percent or less of acquisition costs. In the case of manganese, low-grade domestic deposits were mined at prices 70 to 130 percent above the 1959 market levels. Once the government purchase contracts were terminated, U.S. production of these materials ceased completely and have not been resumed.

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5. See Joint Congressional Committee on Defense Production, Ninth Annual Report on the Defense Production Act (1959).

6. See Charles River Associates, Economic Analysis of the Cobalt Industry (Cambridge, Mass., 1969).

7. See Charles River Associates, Economic Analysis of the Tungsten Industry (Cambridge, Mass., 1969).

Chromite production in the United States also ended with the cessation of DPA contracts.

For a quarter of a century, Title III of the DPA has not been used to support domestic production of nonfuel minerals, with the single exception of an $83 million loan in 1967 to help develop a new copper mine. In 1982, however, the House Committee on Banking, Finance and Urban Affairs reported a bill (H.R. 5540, 97th Congress) amending the Defense Production Act of 1950 to authorize the appropriation of $5 billion over a five-year period for loans, loan guarantees, purchase agreements, and price guarantees intended to assist the modernization of industries in the United States that are necessary to the manufacture or supply of national defense materials. Assistance would be provided to firms engaged in expansion of the domestic capability to produce or process critical strategic metals, minerals, and materials. An additional $1.75 billion would be authorized for a five-year program for skills training and for modernizing the equipment of schools of higher education engaged in such skills training.

The proposal risks repetition of the 1950s experience--temporary expansion of uneconomic domestic mining and minerals processing at very high cost. In the early 1950s, shortages and rapidly escalating prices in foreign markets jeopardized a needed rapid increase in defense production. The current defense buildup faces no such threat. The minerals industry--at home and abroad--is experiencing a sharp decline in production and employment, mine shutdowns, and considerable excess capacity. 8/

For example, it is estimated that a floor price in the $25 per pound range, guaranteed for ten years, would have to be set to induce domestic production of cobalt. 9/ By late 1982, cobalt was selling on the spot market at $4 per pound and stockpile purchases were made in 1981 at $12.50 to $15 per pound. While a pound of annual domestic productive capacity is equal to the three pounds of stockpiled material necessary to meet the three-year mobilization goal (presuming the capacity exists in time), subsidizing domestic production would risk paying twice or more the world price for a ten-year period. Nor is it likely that productive capacity would remain in place after government purchases were suspended unless it could operate at competitive prices.

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8. See U.S. Bureau of Mines release, 1982 Raw Non-Fuel Mineral Production (January 19, 1983).

9. Congressional Budget Office, Cobalt: Policy Options for a Strategic Mineral (September 1982).

Nevertheless, there might be cases when competitive production capacity could be created with the help of some initial public financing. If the required federal subsidy was a low percentage of the market price, it might be preferable to bear this cost than to incur the expense of a three-year stockpile. But, this case would most often apply in metal industries that already have substantial domestic excess capacity and that pose the smallest security risks.

A corollary benefit of providing subsidies for expanding domestic production would be expanded capacity to meet peacetime contingencies. The likelihood of deliberate action by foreign governments to restrict the flow of raw materials to the United States would be reduced if U.S. mines and processing facilities had excess capacity or readily expandable capacity in place. If any contingency did arise, the impact on U.S. production and prices would be lessened to the extent that U.S. needs could be met more fully from domestic sources.

Another corollary benefit would be assistance to the depressed U.S. mining and processing industry, its work force, and its communities. The very real problems of employees and communities could be addressed by other means, however, notably through retraining and assistance in developing other community-based enterprises. It is difficult to justify production subsidy programs unless most of the cost is warranted as an efficient method of insuring the country against the risks of supply shortages.

OTHER OPTIONS

The most immediate and direct way to reduce U.S. vulnerability to disruptions in the flow of foreign minerals is through stockpiling and subsidization of domestic production, although the efficiency with which these options reduce vulnerability differs. In the long term, however, a variety of options are available to insure against the risk of minerals disruptions or to reduce the magnitude of the risk itself. These include the diversification of mineral sources, greater access to mineral deposits on public lands, research and development, and greater emphasis on minerals policy in formulating foreign policy.

Diversification of Sources of Supply

Diversifying sources of supply would offer both U.S. metal-using industries and the country greater assurance that damage from supply contingencies would be contained. For defense emergencies, of course, diversifying away from North American sources would make little sense.

Since sea lanes within the Western Hemisphere are more likely to be safe, expanding Eastern Hemisphere sources could be less desirable. More numerous sources of supply--wherever they may be--also lessen the potential for development of cartels. On the other hand, diversification to countries controlled by potentially hostile regimes carries other risks and unstable regimes offer little promise as reliable long-term suppliers.

For two decades after World War II, investments in foreign mines and foreign processing facilities were substantial, but most of the product was exported to Japan and European industrialized countries. The rest of the industrialized world expanded its metal-using industries at a much faster pace than did the United States during this period. U.S. supplies of almost every imported material continued to come largely from a very few sources, as U.S. importers sought supplies at the lowest costs and were little concerned about reliability. Canadian mineral production expanded rapidly during this period, as did the variety of minerals produced there. Its exports were largely directed to the United States.

Events in the 1960s and 1970s focused attention on the relative reliability of suppliers, particularly in the Third World. As Japan's balance of payments improved, its early foreign investments were concentrated on acquiring new foreign materials supplies and diversifying its sources as much as possible. The U.S. minerals industry encountered more competition in its efforts to develop foreign production and more difficulty in finding a hospitable reception in the Third World. Australia and South and West Africa became centers for new minerals investment, attracted by an apparently more hospitable environment than existed in other areas with resource export potential.

Nevertheless, a relatively few foreign supply sources still predominate for almost every mineral. The U.S. government has very few means for inducing users of foreign materials to diversify their sources. The Western Hemisphere Trading Act did provide tax incentives for private investment in the Western Hemisphere, but that legislation has expired. U.S. foreign investment incentives, including investment insurance, do not discriminate in favor of those areas that would represent additional diversification.

Multilateral and bilateral aid programs and investment guarantees could reduce U.S. supply vulnerabilities by expanding and diversifying foreign production of critical and strategic materials. The aid programs would not need to finance minerals or metals processing investments directly. They could contribute to creating a climate in which private-sector investments would be attractive or they could finance infrastructure construction that would both promote private mineral investment and enhance other development. Such aid programs would increase budgetary expenditures only if aggregate aid levels increased. The investment insurance programs have been self-financing to date.

Access to Public Lands

About one-third of the land area of the United States (some 734 million acres) consists of public lands, much of it designated as public parks, wilderness, and wilderness study areas. The President has stated that 40 to 68 percent of federal land is now estimated to be closed to minerals exploration and development. Controversy has long persisted about whether these lands should be preserved for recreational and aesthetic uses or opened for minerals exploration and development. Preservationists oppose exploration even by the government, lest development follow. Mining interests are reluctant to finance exploration unless mineral finds can be developed. As a result, the United States has hardly begun assessing the minerals potential of most public lands.

Knowledge that useful domestic resources exist could lead to their development during a contingency, though a high priority given to preservation could limit such use to situations of extreme severity and duration. Such knowledge could be obtained through more intensive exploratory surveys by the U.S. Geological Survey. Such surveys could lead to substantial mineral finds that might reduce the need to resort to much more expensive alternative provisions against contingencies. 10/

Research and Development

Research and development (R&D) has and could reduce U.S. vulnerability to shortages of imported minerals and metals through contributions to improving every step of the extraction and industrial production process. In mining, it could enable the economic exploitation of lower quality ores, deeper mining, and the exploitation of smaller veins. It could facilitate more efficient processing and recycling, conservation of scarce minerals, and the substitution of more available materials for those in scarce supply. Some resulting technologies might become economical even under normal supply conditions. Others could be held in reserve until supply shortages and the ensuing price increases made it feasible to incur the additional cost, as was the case for cobalt in 1978. Analyses of individual minerals in the preceding two chapters present numerous examples of new technologies that

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10. The details of such a survey can be found in Congressional Research Service, Assessing the Mineral Potential of the Public Lands, Report no. 82-XXX 5 (May 1983).

have already become economical and are in use or that would become so if shortages led to significant price increases.

The federal government now accounts for about one-half of U.S. expenditures on R&D for minerals. Four percent of its R&D budget is devoted to funding 20 percent of the country's $5.4 billion expenditure on R&D in this area. 11/ These federal R&D expenditures, however, have been mainly for fuels and renewable resources rather than for nonfuel minerals. And most of the nonfuel mineral expenditures have been used for materials utilization, evaluation of materials properties, and the development of special materials substances derived from nonfuel minerals. 12/ Basic resource development and processing have been relatively neglected. The Administration's proposed increase in fiscal year 1984 funding for the National Science Foundation, which promotes basic research, might reverse this trend. If not, the Congress might wish to consider legislation to promote R&D for nonfuel minerals and metallurgical science.

The 80 percent of minerals R&D funded by private firms is designed to develop new products and/or increase their competitiveness. However, government funds are essential to help extend the base of scientific knowledge for substitution, conservation, and new materials applications. Private firms do underwrite some basic research, even though its results benefit competitors as well as themselves. That fact limits the funds that private firms can be expected to devote to this use, however.

Compared to the cost of acquiring and maintaining inventories or subsidizing production, research and development might prove inexpensive. If directed particularly toward those materials for which U.S. reliance on foreign sources entails some vulnerability, it could reduce risks considerably, as it has already.

Foreign Policy and Diplomatic Initiatives

If wars represent the failure of diplomacy, the same may be said of contingencies that might create serious shortages of critical or strategic nonfuel minerals. Foreign policy requires setting priorities among competing national interests that constantly arise in dealing with foreign governments. U.S. interests in reducing vulnerabilities to raw materials shortages

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11. U.S. Department of Commerce, Critical Materials Requirements, 1981.

12. Batelle-Columbus Laboratory, Assessing the Adequacy of R&D (Columbus, Ohio, February 1979).

have often fallen by the wayside, sometimes because the issue has not been adequately focused on and understood in the policymaking process. Nevertheless, if diplomacy was effective in reducing such vulnerabilities, the economic cost could be very low.

As noted in a recent study, foreign policy could be addressed to any or all of the following: facilitating new exploration and mining; protecting existing mining investment; encouraging political stability and unhampered flow of supplies to foreign markets; encouraging new governments to maintain and expand minerals production and export; discouraging foreign government support of private cartels or participation in restrictive intergovernmental agreements; diversifying sources of supply; encouraging foreign governments to be dependable and reliable suppliers. 13/

Multilateral investment insurance is a promising instrument for encouraging more minerals exploration and development in the Third World. The idea was revived by the current president of the World Bank and endorsed by the U.S. government. The reluctance of many developing countries to participate in such programs has not received much priority in U.S. diplomatic relations with those governments. A higher priority for expanding minerals and metals productive capacity has only recently received much attention in the World Bank's lending program. An opportunity remains for stimulative efforts in U.S. policy toward the World Bank and other multilateral lending agencies.

From a materials vulnerability standpoint, the most important problems for U.S. foreign policy are those in central and southern Africa--South Africa, Zimbabwe, Gabon, Zaire, Zambia, Angola, and Mozambique. The achievement of independence in Zimbabwe has eased the problems of U.S. vulnerability to the interruption of chromium supplies from South Africa, but the reliability of its supplies would be much enhanced if they could be transported effectively and securely through Mozambique rather than South Africa.

Minority rule in South Africa remains a problem in U.S. relations with other African countries and is a source of continuing concern over the reliability of South African supplies, particularly for chromium, platinum, manganese, and industrial diamonds. The present South African government is a reliable supplier and has every reason to remain so in the foreseeable future. Its prospects for retaining control indefinitely are much less promising. If a successor regime took power under conditions that

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13. Resources for the Future, Major Mineral Supply Problems, Chapter 17, "Foreign Policy Implications."

heightened resentment toward the United States for supporting the present regime, the country could become a much less reliable supplier. Its need for foreign exchange should be a mitigating factor, however, under most circumstances. A friendly successor regime could offer more durable protection for U.S. vulnerabilities.

The risk of peacetime supply interruptions might be more responsive to U.S. diplomatic efforts. A careful foreign policy review, focused on the sources of U.S. concern about materials vulnerability and the possible means of mitigating the likelihood of an interruption or limiting its consequences, could suggest diplomatic efforts that might yield substantial benefits without significant cost to other U.S. interests. The financial cost of such a review and of the measures that it might suggest is unlikely to be large.

APPENDIX

TABLE A-1. STATUS OF THE NATIONAL DEFENSE STOCKPILE FOR STRATEGIC MINERALS (As of March 31, 1982)

Mineral	Stockpile Goal (In thousands) a/	Existing Stockpile (In thousands)	Percent Complete
Aluminum Metal Group	7,150	3,444	48
Aluminum	700	2	2
Bauxite, metal grade, Jamaica type	21,000 LDT	8,859	42
Bauxite, metal grade, Surinan type	6,100 LDT	5,300	86
Aluminum Oxide	638	259	41
Abrasive grain	0	51	Excess
Fused crude	0	250	Excess
Bauxite, abrasive grade	1,000 LCT	0	0
Antimony	36	41	Excess
Asbestos, Amosite	17	43	Excess
Asbestos, Chrysotile	3	10	Excess
Bauxite, Refractory	1,400 LCT	175	12
Beryllium Metal Group	1.2	1.1	87
Ore	18	18	100
Beryllium copper metal alloy	8	7	94
Beryllium metal	0.4	0.2	57
Bismuth	2,200 LB	2,081	95
Cadmium	11,700 LB	6,329	54
Chromium, Chemical and Metallurgical Group	1,353	1,325	98
Chromite, chemical grade ore	675 SDT	242	36

(Continued)

TABLE A-1. (Continued)

Mineral	Stockpile Goal (In thousands) a/		Existing Stockpile (In thousands)	Percent Complete
Chromium, Chemical and Metallurgical Group (Continued)				
Chromite, metallurgical grade ore	3,200	SDT	2,488	78
Chromium, ferro, high carbon	185		403	Excess
Chromium, ferro, low carbon	75		319	Excess
Chromium, ferro, silicon	90		58	65
Chromium, metal	20		4	19
Chromite, Refractory Grade Ore	850		391	46
Cobalt	85,400	LB	40,802	48
Columbium Group	4,850	LB	2,511	52
Columbium carbide powder	100	LB	21	21
Columbium concentrates	5,600	LB	1,780	32
Columbium, ferro	0		931	Excess
Columbium metal	0		45	Excess
Copper	1,000		29	3
Diamond, Industrial Group	29,700	KT	40,952	Excess
Diamond die, small	60	PC	25	42
Diamond, industrial, crushing bort	22,000	KT	23,693	Excess
Diamond, industrial, stones	7,700	KT	17,246	Excess
Fluorspar, Acid Grades	1,400	SDT	896	64

(Continued)

TABLE A-1. (Continued)

Mineral	Stockpile Goal (In thousands) a/	Existing Stockpile (In thousands)	Percent Complete
Fluorspar, Metallurgical Grade	1,700 SDT	412	24
Graphite, Natural			
Ceylon, amorphous lump	6.3	5.5	8.7
Malagasy, crystalline	20	18	90
Other	2.8	2.8	100
Iodine	5,800 LB	7,756	Excess
Jewel Bearings	120,000 PC	70,424	59
Lead	1,100	601	55
Manganese Dioxide, Battery Grade Group	87 SDT	222	Excess
Natural ore	62 SDT	219	Excess
Synthetic dioxide	25 SDT	3	12
Manganese, Chemical, and Metallurgical Group	1,500	1,971	Excess
Ore, chemical grade	170 SDT	221	Excess
Ore, metallurgical group	2,700 SDT	3,370	Excess
Ferro, high carbon	439	600	Excess
Ferro, medium carbon	0	29	Excess
Ferro, silicon	0	24	Excess
Metal, electrolytic	0	14	Excess
Mercury	10.5 FL	189	Excess
Mica, Muscovite, Black, Stained, and Better	6,200 LB	5,212	84
Mica, Muscovite Film, First and Second Qualities	90 LB	1,274	Excess

(Continued)

TABLE A-1. (Continued)

Mineral	Stockpile Goal (In thousands) a/	Existing Stockpile (In thousands)	Percent Complete
Mica, Muscovite Splittings	12,630 LB	18,707	Excess
Mica, Phlogopite Block	210 LB	131	62
Mica, Phlogopite Splittings	930 LB	1,681	Excess
Nickel	200	32	16
Platinum Group Metals			
Iridium	98 TROZ	17	17
Palladium	3,000 TROZ	1,255	42
Platinum	1,310 TROZ	453	35
Quartz Crystals	600 LB	2,066	Excess
Rutile	106 SDT	39	37
Sapphire and Ruby	0 KT	16,306	Excess
Silicon Carbide, Crude	29	81	Excess
Silver (Fine)	0 TROZ	137,506	Excess
Talc, Steatite Block and Lump	.028	1.1	Excess
Tantalum Group	7,160 LB metal	2,392	33
Tantalum carbide powder	0 LB	29	Excess
Tantalum metal	0 LB	201	Excess
Tantalum minerals	8,400 LB	2,551	30
Thorium Nitrate	600 LB	7,132	Excess

(Continued)

TABLE A-1. (Continued)

Mineral	Stockpile Goal (In thousands) a/	Existing Stockpile (In thousands)	Percent Complete
Tin	42.7 MT	194.6	Excess
Titanium Sponge	195	32,3	17
Tungsten Group	50,666 LB metal	79,875	Excess
Carbide powder	2,000 LB	2,033	Excess
Ferro	0 LB	2,025	Excess
Metal powder	1,600 LB	1,899	Excess
Ores and concentrates	55,450 LB	86,860	Excess
Vanadium Group	8.7	0.5	6
Ferro	1.0	0	0
Pentoxide	7.7	0.5	7
Zinc	1,425	378	27

a. Short tons unless otherwise indicated, as below:

FL = flask
KT = karat
LB = pounds
LCT = long calcined ton
LDT = long dry ton
LT = long ton
MT = metric ton
PC = piece
SDT = short dry ton
TROZ = troy ounce